



# **2013 Annual Summary**

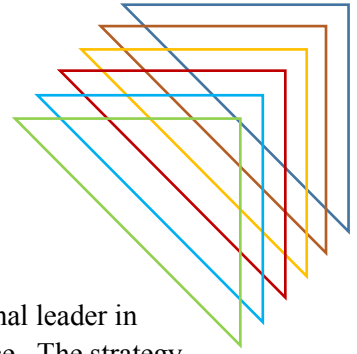
**Kentucky Department for Energy Development  
& Independence**

**Kentucky Energy & Environment Cabinet**





# Foreword



In 2008 Governor Steve Beshear put forth a bold challenge to position Kentucky as a national leader in energy technology and production to help lead the nation toward greater energy self-reliance. The strategy for achieving that challenge was defined in the Governor's action plan, *Intelligent Energy Choices for Kentucky's Future*. The plan was designed to be a "living" document to improve the quality and security of life for all Kentuckians by creating efficient, sustainable energy solutions and strategies; by protecting the environment; and by creating a base for strong economic growth over the long term.

Since that initial challenge and plan the Energy and Environment Cabinet (EEC) and the Department for Energy Development and Independence (DEDI) have worked diligently to initiate discussions and develop energy opportunities that better the Commonwealth. That work has accelerated developments in fossil energy, renewable energy and energy efficiency for all Kentuckians.

This year the Cabinet has continued that drive and completed several analyses designed to encourage in-depth discussions among policymakers and our citizens regarding our energy future and economy. We are seeing Kentucky's energy landscape change before us and we need to be positioned to shape that change rather than just merely react to external forces.

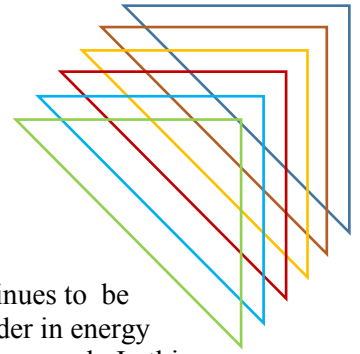
Our efforts remain focused to improve the quality of life for all citizens by simultaneously creating efficient, sustainable energy solutions and strategies; by protecting the environment; and by creating a base for strong economic growth.

This annual summary provides a brief overview of DEDI's programs and projects that are helping shape Kentucky's energy future.

More information about DEDI's activities can be found at <http://energy.ky.gov>.



# Dr. Len Peters



Fellow Kentuckians

Energy issues dominated 2013 from the start with abundant, low priced natural gas to President Obama's Climate Action Plan to the effect these events are having on coal production and employment in Kentucky. Every year energy issues seem to become more dynamic and impactful on Kentucky and this year was no exception.

The development of the nation's shale gas reserves has resulted in record high production of natural gas with relatively low and stable prices affording electric utilities new opportunities for electricity generation. This development, coupled with new and proposed federal environmental regulations on power plants, is shifting the nation's reliance from coal to natural gas to generate electricity. Recently, the U.S. Energy Information Administration predicted that by 2040, natural gas will account for 35 percent of the nation's total electricity generation, while coal will account for 32 percent. This shift toward natural gas electricity generation is reducing demand for Kentucky's coal resources. In 2013, the department tracked Kentucky's coal production and mining employment and documented a 12 percent decrease in coal production and a 23 percent decrease in mine employment.

To help assess the impact that these changes will have on Kentucky, the department helped develop two reports issued by the cabinet. One report addressed the framework for future federal carbon emission policy and the other analyzed the economic implications of these carbon emission policies on Kentucky's electricity generation and economy. Both reports help explain the importance that energy and environmental policies have on Kentucky's long-term economic wellbeing. They are available for review on the cabinet's Web site.

In addition to energy policy work, the department is actively managing 46 grants representing more than \$22 million. These grants support programs and projects in Kentucky for energy efficiency and renewable energy, as well as energy research and coal education. Through

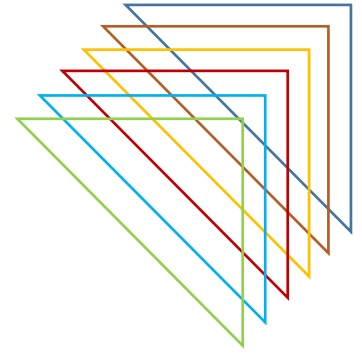
these efforts Kentucky continues to be recognized as a national leader in energy efficiency and fossil energy research. In this annual summary please review these activities to see how the department is helping Kentucky's schools, businesses, industries and communities.

I appreciate your trust and confidence as we help shape Kentucky's energy future. We must continue to work together to solve the energy challenges that lie ahead of us. Thank you for the opportunity to serve as your cabinet secretary.

Leonard Peters  
Secretary  
Kentucky Energy and Environment Cabinet



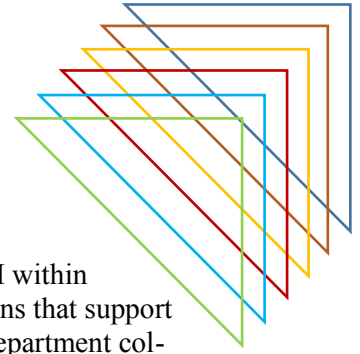
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# DEDI Organization



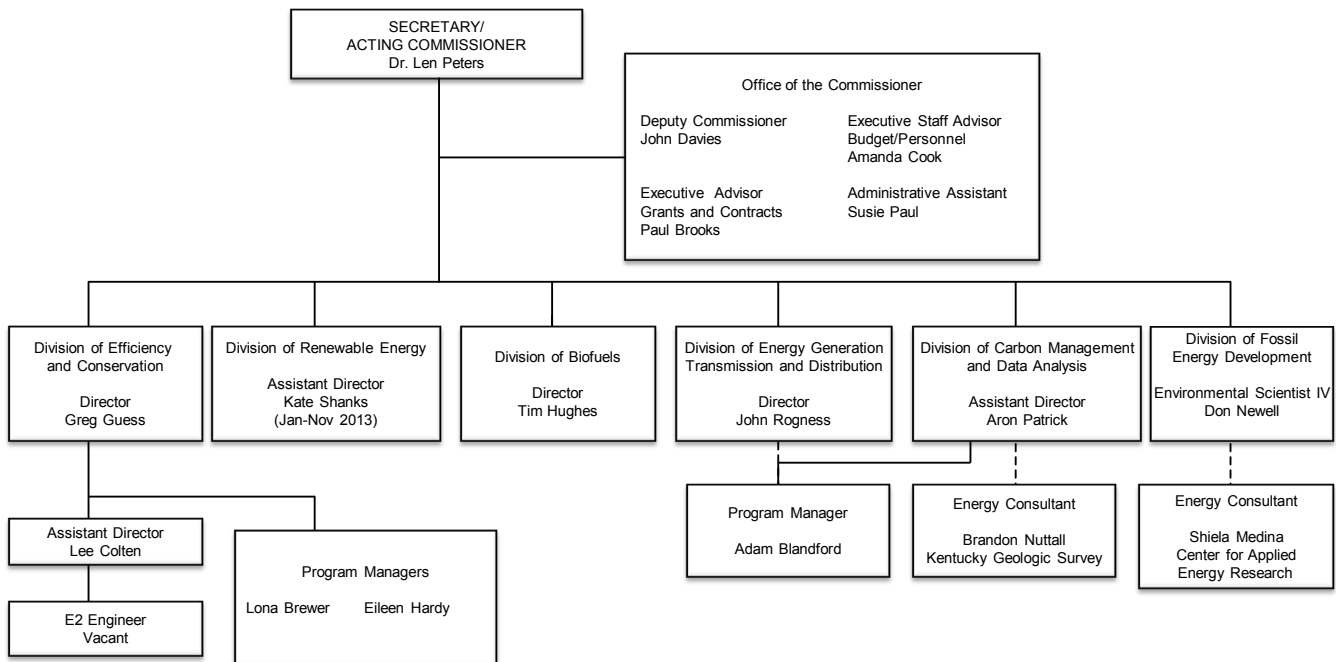
The Kentucky General Assembly enacted legislation (KRS 152.712) that established DEDI within the Energy and Environment Cabinet in 2008. The department was created with six divisions that support implementation of Governor Steve Beshear's energy plan and policies. Additionally, the department collaborates with both the University of Kentucky's Center for Applied Energy Research and the Kentucky Geological Survey, which provide technical expertise and advice.

When established, the department was authorized 29 fulltime employees to help with the management of the American Recovery and Reinvestment Act funds. With the conclusion of Recovery Act funding, the department right sized its staffing levels and ends the year with 13 employees.

DEDI's mission is to improve the quality and security of life for all Kentuckians by creating efficient, sustainable energy solutions and strategies and promoting clean, reliable, affordable energy sources that help Kentucky improve energy security, reduce emissions, and provide economic prosperity. Additionally, the department supports and encourages energy-related research and development that will benefit Kentuckians.

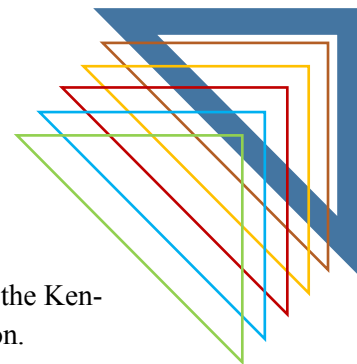
A short summary highlighting the accomplishments and grants managed by each division follows.

## DEPARTMENT FOR ENERGY DEVELOPMENT AND INDEPENDENCE



Revised 12/31/13

# Division of Efficiency and Conservation



**T**he Division of Efficiency and Conservation provides leadership to maximize the benefits of energy efficiency and conservation through awareness, research and technology by embracing new and existing partnerships. It is charged with implementing the Governor's goal of offsetting at least 18 percent of Kentucky's projected 2025 energy demand through energy efficiency. Though no easy task, the broad spectrum of new initiatives and energy programs currently underway will lead the way toward meeting Kentucky's energy goals.

The division focuses on market transformation to accomplish this mission. By strengthening its existing partnerships and embracing new opportunities, energy efficiency programs are changing how Kentucky produces, uses and conserves energy. 2013 was the year of strategic transition, as the department sought to put many of its programs on a more sustainable path. Division staff worked with 30 partner agencies and organizations to identify sustainable efficiency programs. Today there are more than 30 programs in place in various sectors of Kentucky's economic landscape, including agriculture, research, education, local government, residential, commercial and industrial sectors.

The programs outlined on the following pages represent innovative leadership and also reflect the dedication and creativity of the division's partners and staff to pursue energy solutions.

For example, energy efficiency programs have benefited the housing and education sectors by creating or retaining jobs and by reducing greenhouse gas emissions and energy consumption. Two programs in particular are the School Energy Managers Project (SEMP), administered by the Kentucky School Boards Association, and the Kentucky Home Performance

Program administered by the Kentucky Housing Corporation.

The division is also managing two projects that resulted from successful application for competitive grants from the U.S. Department of Energy (DOE). The Energy Efficiency Awareness and Action program is engaging citizens to reduce energy consumption through efficiency utilizing the 'grass-roots' efforts of Kentucky's Cooperative Extension Service. The Department for Local Government/Energy Savings Performance Contracting (DLG/ESPC) project provides education and technical assistance to local governments on programs that reduce energy consumption, greenhouse gas emissions and utility costs.

The division also provides oversight to 13 projects and programs funded by an EEC environmental mitigation settlement fund, which resulted in \$11.2 million through 2015. This funding will help strengthen existing programs as well as support new energy efficiency and renewable energy projects in the Commonwealth.

Although new energy policies are on the horizon, the division is poised with innovative, cost-effective energy programs to meet the energy needs of tomorrow. A review of 2013 program activities follows.

## **Kentucky School Energy Managers Project (SEMP)**

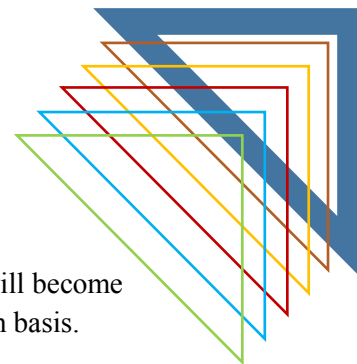
In 2013 EEC awarded the Kentucky School Boards Association (KSBA) \$750,000 over 2.5 years to support the SEMP in school districts in Kentucky. Based on actual progress of the program to date, the project expects to produce \$2.4 million in annual energy cost avoidance by fiscal year 2016. Funding provides partial salary for energy managers hired by school boards to reduce energy consumption and costs. Thirty-four (34) energy managers are serving 75 school districts under this initiative. Funding also provides for a small

# Efficiency and Conservation

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staff at KSBA to administer the program, provide training opportunities for energy managers, organize reporting and provide marketing efforts for the program. The project, originally initiated in 2009, has attracted the attention of electric utilities and is now being funded by Louisville Gas and Electric/Kentucky Utilities (LG&E/KU) in its service territories as part of the company's demand-side management activities. Other utilities are evaluating their participation in the program within their service territories, thus increasing the like-

lihood that the program will become sustainable on a long-term basis.

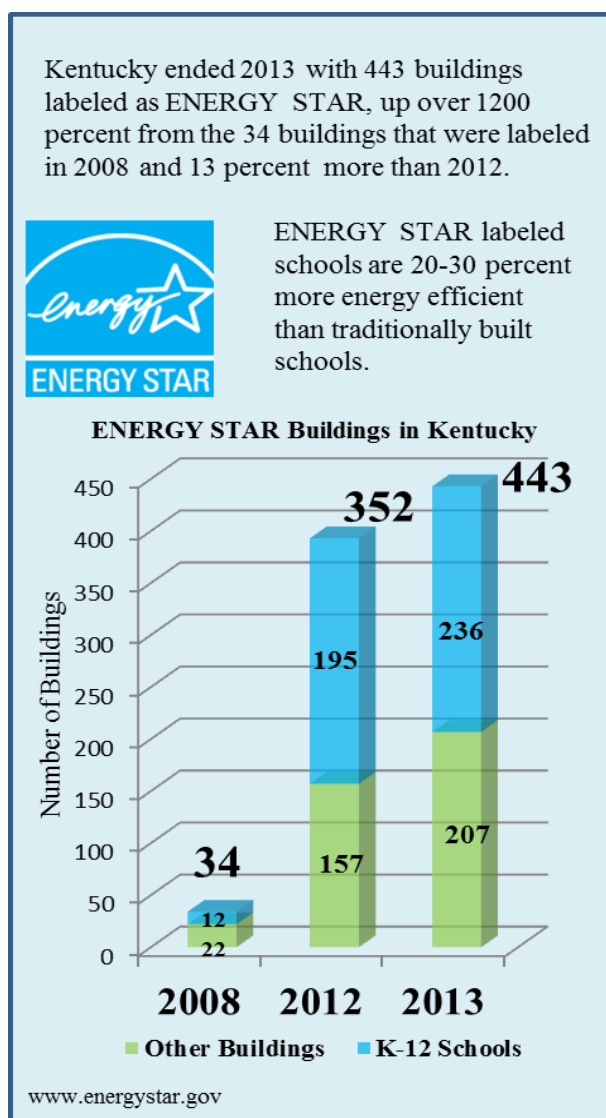


## Industrial Plant Energy Efficiency Upgrade

The Lord Corporation's Bowling Green plant, producer of bonded rubber parts for the vehicle and equipment industries, is investing over \$1 million to install and operate energy efficient equipment and a new energy management control system. To assist in this initiative EEC is providing a grant of \$504,000. Lord Corporation plans to replace an inefficient chiller with a new chiller and associated controls; replace a steam generation system with a high-efficiency boiler; and install a rubber preheater metering and scheduling system. The project will be accomplished through a complete turn-key installation and commissioning process and will have a simple payback of 5.5 years. Lord Corporation is expected to realize an annual utility savings of more than \$170,000 and a 1,433 metric ton reduction of CO<sub>2</sub>.

## Kentucky Home Performance

The Kentucky Housing Corporation (KHC) received a \$3 million grant from EEC to support the ongoing Kentucky Home Performance Program and expand the program's financial services to homeowners. The grant will fund three years of program operations during which at least 611 additional energy efficient retrofits will be completed. The program is designed to provide reliable information to homeowners concerning how efficient their existing home performs, what can be done to improve the home, and how long the investment in each measure (e.g., insulation, sealing infiltration leaks, replacing HVAC or other measures) will take to "pay back" the original investment. The program will focus primarily on owner-occupied, single-family energy efficiency retrofit loans ranging from \$1,000 - \$25,000 per home. Using \$500,000 of remain-





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ing American Recovery and Reinvestment Act (ARRA) and the \$3 million of funds from EEC, KHC is partnering to establish a low-interest revolving loan fund. This loan program is known as Warehousing for Energy Efficiency Loans (WHEEL) and is the nation's first attempt to provide low cost, large scale capital for state and local government and utility-sponsored residential energy efficiency loan programs. As this program expands, it should produce enough revenue to sustain program operation.

## "On-farm" Energy Efficiency & Production

The Governor's Office of Agricultural Policy (GOAP) received a grant award of \$750,000 for a three-year period from EEC to support energy efficiency and renewable energy projects on Kentucky farms. This program provides incentives for Kentucky's farm families to increase energy efficiency and renewable energy production in the Commonwealth and leverages match-



More energy efficient ventilation fans were just one of several measures used to lower energy use at this poultry farm in Western Kentucky

ing funding made available through Kentucky Agricultural Development Funds for these initiatives. The program will continue to increase producer awareness of the opportunities to improve energy efficiency and production of useable energy within their farming operations. The program is a continuation of the successful partnership between DEDI and GOAP originally funded through the American Recovery and Reinvestment Act in 2009.

## Fayette County Public Schools Integrated Live Energy Management

EEC awarded Fayette County Public Schools (FCPS) \$335,000 in 2013 to support completion of the integrated live energy metering project. The project comprises real-time energy monitoring equipment, live data analysis software, and a district-wide, public energy and sustainability education portal. The completed project, expected to be fully implemented in 2014, is estimated to reduce building energy consumption by 20 percent, to save more than \$1.1 million a year in energy costs and reduce CO<sub>2</sub> emissions by more than 11,000 metric tons per year. FCPS is one of the state's leaders in the adoption of real-time tracking of energy consumption.

## **Energy Efficient Modular Buildings**

Southern Tier Housing Corporation (STHC) was awarded a grant of \$504,000 for a three-year period by EEC to support energy modeling and design research to develop more cost-effective and energy-efficient factory built structures, Houseboats to Energy Efficient Residences (HBEER). The project will include construction of four new energy-efficient, factory-built structures equipped with photovoltaic generation systems. The program is a continuation of the partnership between DEDI and the Kentucky Highlands Investment

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Corporation, with which STHC is affiliated, that was originally initiated with Recovery Act funding in 2009. In addition to providing energy-efficient affordable housing to low-income buyers, the program is designed to develop a market for factory-built modular homes and provide jobs for workers in the region who formerly worked in the dozen or so houseboat factories in the area that were adversely impacted by the recent recession.



The original HBEER home being set in place in Monticello, Kentucky.

### How\$martKY - On-bill Financing - Energy Efficiency Retrofit

A partnership between DEDI and the Mountain Association for Community Economic Development (MACED), funded by a \$300,000, two and a half-year grant from EEC, provides “on-bill” financing for energy-efficiency improvements for homeowners served by three participating rural electric cooperative corporations (RECCs) in eastern Kentucky. The How\$martKY Program offers homeowners the opportunity to receive

energy efficiency audits and provides loans to implement energy efficiency upgrades to their homes. The program provides a line of credit that allows participating electric co-ops to pay for energy efficiency improvements on select residences. In exchange for the costs of efficiency upgrades, the loan repayment is added to the utility bill of the participating residence as a fixed monthly charge, paying for the energy efficiency investment during the term of amortization. Efficiency measures are selected and the loan is structured such that the reduced energy bill and loan repayment together are lower than the bill was before the improvements, giving the customer a net positive cash flow from the first month. Individual customers will bear little to no upfront cost for the price of the energy efficiency improvements, with the long-term goals of helping co-op customers realize a net reduction in their monthly utility bills and helping utilities shave peak energy demand. Having the loan repayment as part of the electric bill reduces the default rate, thus attracting loan capital and reducing the interest rate. This arrangement also benefits the homeowner – if the house is sold, the loan balance stays with the meter and the new owner gets the benefits of the efficiency improvements. MACED is matching the grant award with \$320,000 from their resources. Residential energy efficiency improvements play an important role in helping electric utilities in Kentucky reduce energy consumption, energy supply requirements, and individual consumer costs.

### Energy Efficiency and Conservation for Local Governments

In the Spring of 2013 the Department for Local Government (DLG) was awarded \$1.2 million by EEC to support continuation of activities previously funded with Recovery Act appropriations. Under the program, cities and counties applied competitively for grants to

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increase their community's energy efficiency by developing projects that reduce energy consumption, greenhouse gas emissions and utility costs for local governments. Some of the remaining funding from the Recovery Act was also used to establish a low-interest revolving loan fund for the program. Another federal grant (see "Local Government Energy Retrofit Program") provides funding for technical experts to assist local governments with procuring, managing and evaluating energy savings performance contracts (ESPCs) that significantly reduce energy consumption in government facilities.

### **Green Bank**

The [Green Bank of Kentucky](#) was created by an administrative order of the Finance and Administration Cabinet (FAC) in 2009, and was initially funded by a DEDI grant of \$14.4 million in Recovery Act funds. The Green Bank is administered by FAC through a partnership with DEDI. The mission of the Green Bank of Kentucky is to promote energy efficiency in state buildings through competition for low-interest loans to reduce operating costs and energy use, protect the environment, save taxpayer dollars, promote economic development, and create new green-collar jobs by means of education, engineering analyses and building improvements.

The Green Bank is a revolving loan fund primarily used for energy savings performance contracts (ESPC) on state-owned facilities. With the initial balance of funds loaned out, Green Bank repayments are being rolled over to finance new energy-efficient improvements in other state buildings. The Green Bank is able to loan money at very low interest rates, thus allowing more energy conservation measures to be implemented on a project. If additional funding can be made available to the Green Bank, its pool of money for energy

efficiency improvements could be expanded to provide loans to local governments and school systems.

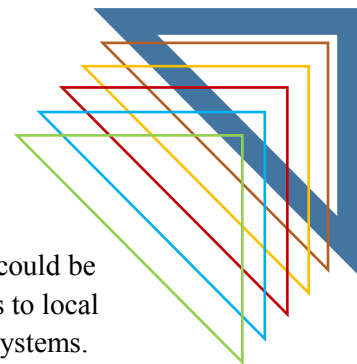
### **High Performance Schools Workshop**

The partnership between DEDI and the Kentucky National Energy Education Development Project (KY NEED) is grounded in promoting energy education in schools. For more than a decade, DEDI and KY NEED have produced the High Performance School Workshop to extend energy education to school leaders and professionals in the design and construction of Kentucky's K-12 schools.

DEDI awarded KY NEED a \$50,000 grant to produce the 2013 Workshop. For two days in March, nearly 100 school administrators, architects and engineers gathered to learn first-hand the components of high performance schools and the integral role these schools have in student learning. The workshop also provided an on-site tour of Kenton County School District's Turkey Foot Middle School, a net-zero ready school featuring the latest in green technologies. The school district is also a national model for sustainable practices and education innovation. The workshops target audiences including architects, engineers, and school officials, particularly those officials who are from districts that plan to build or renovate within the coming years.

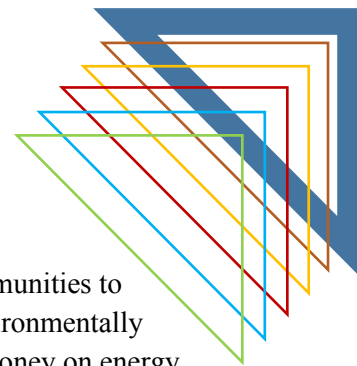
### **Stimulating Energy Efficiency in Kentucky (SEE KY)**

The SEE KY program was initially funded by U.S. DOE with \$500,000 during 2011 to identify programs and policy options to help Kentucky realize a 1 percent annual electricity energy savings through energy efficiency. This three-year, stakeholder intensive process included working groups in the residential, commercial and industrial sectors to prioritize issues and barriers to



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efficiency. The resulting [SEE KY plan](#) provided a set of 27 short-, near-, and long-term recommendations that can foster the adoption and utilization of energy efficiency in the Commonwealth. Some recommendations focused on collaboration and coordination, such as the topics related to manufactured housing; additional program resources were identified such as a need for energy code compliance and the KY Home Performance program; financing, tax credits and other incentives were deemed critical for the industrial sector; and some issues were recommended for further discussion, such as the industrial opt-out provision of jurisdictional utility DSM programs overseen by the Public Service Commission. Many of these issues are being developed by DEDI and various stakeholders in order to implement the recommendations of the SEE KY plan.

### **Energy Efficiency Awareness and Action (EEAA)**

Built on the long-standing partnership between DEDI and the University of Kentucky's Cooperative Extension Service (UK CES), EEAA continued to operate in 2013 under the existing federal funding award of \$200,704 from 2011. On-going training programs have provided CES agents in 120 Kentucky counties step-by-step instructions to measure energy efficiency, review utility bills, and to benchmark a building or home's energy performance. Agents are trained to use an energy-consumption analysis tool and the ENERGY STAR Portfolio Manager program to assess the energy efficiency of homes and offices, respectively. It has also introduced a significant number of 4-H youth to energy efficiency and equipped them with the right tools to assist their households to improve their environment.

The training sessions, combined with community outreach and program endorsement by the UK CES director proved to be key components to engage program participation. Throughout 2013, UK CES agents were

reaching out to their communities to help them learn to be environmentally responsible and to save money on energy costs. In September, 29 agents were recognized for their participation in an Energy Awareness Challenge competition. As the EEAA program continues, UK CES agents and 4-H members will utilize a 'grass roots' approach to share knowledge gained from their own experiences to disseminate the EEAA services within their local community.

### **Local Government Energy Retrofit Program (LGERP)**

Under a competitive award through U.S. DOE, Kentucky received a grant to implement a three-year pilot project to assist local governments with the energy savings performance contracting (ESPC) process. In a partnership between the Department for Local Government (DLG) and DEDI, LGERP will implement strategies to promote a comprehensive system-wide approach to energy efficiency and conservation of buildings, street lighting, or water infrastructure improvements through the use of ESPCs. ESPCs provide a financing mechanism that pays the cost of energy improvements from the money saved when utility costs are reduced. An added benefit to local government is that the energy services company (ESCO) that oversees the project guarantees that the customer will achieve the targeted savings level or the ESCO will pay the difference. ESPCs are utilized in Kentucky extensively by the state government, the state's public universities, and some of the larger municipal jurisdictions, such as Louisville, Lexington, and Covington. Over the last 10 to 12 years, these groups are estimated to have completed \$750 million in projects. However, only rarely have local governments used ESPCs. This is particularly true for the smaller cities and counties. The LGERP project is partnering with existing organizations —





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including the Kentucky League of Cities (KLC), the Kentucky Association of Counties (KACo), and area development districts (KCADD), — to leverage existing bond pools to fund efficiency projects, provide communications and training networks to local governments on ESPCs, and provide legal and technical support to local governments in the entire ESPC process.

### University of Kentucky (UK) Cooperative Extension Service Partnership

DEDI continued its decade-long partnership with the University of Kentucky's Cooperative Extension Service (CES). Through a \$100,000 grant provided by DEDI, CES provided ENERGY STAR information statewide through its network of county extension agents. The grant supported a CES agent who acted as a "circuit rider," taking an exhibit featuring various residential energy-efficiency technologies to between 40 and 50 venues across the state annually – to fairs, RECC membership meetings, trade shows and other events. The Kentucky State Fair is the highlight of the CES annual exhibit schedule. The exhibit, shared with the UK College of Agriculture, included 3,000 sq. ft. of hands-on materials and it played center stage in the South Wing — Main Street pavilion. It is estimated that more than 400,000 fair attendees viewed the exhibit. Extension agents on site at the fair exhibit were also able to provide private consultations with homeowners and contractors. After years of interaction with the Extension resources, many homeowners have developed an allegiance to this nonprofit, non-marketing, unbiased clearinghouse of information and quality coaching.

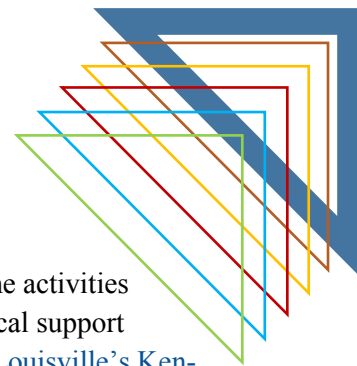
### **Save Energy Now**

Originally funded by U.S. DOE and DEDI in the amount of \$518,125 beginning in 2009 and ending in

2013, the award funded the activities of engineering and technical support staff at the [University of Louisville's Kentucky Pollution Prevention Center \(KPPC\)](#) to help manufacturing companies operate more energy efficiently through the Save Energy Now (SEN) program. In addition to providing technical assistance, SEN required participating industries to pledge to save 2.5 percent in energy usage annually. The program provided a step-wise program of recognition and peer mentoring. KPPC provided detailed technical assessments of an industrial facility, identifying equipment and retrofits that make for a short return on investment. Improvements typically involve energy efficient lighting and HVAC equipment, repair and upgrading of compressed air equipment and steam pipes, adoption of combined heat and power, and bill analysis. Assessments also provided information on capital costs of improvements, energy savings, and pay-back period. In addition to providing these types of analyses, KPPC also hosted regular meetings with manufacturers where participants could share successes and receive recognition among peers. The program closed out at the end of 2013.

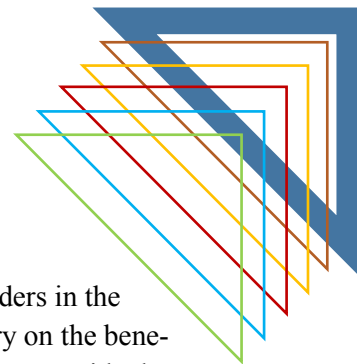
### **Local Partnerships**

DEDI works with numerous local partners to identify opportunities for collaboration and to seek initiatives. One example is DEDI's partnership with the [Louisville Energy Alliance \(LEA\)](#). LEA hosts an annual energy efficiency competition among commercial building owners and operators called the ENERGY STAR Kilowatt Crackdown. DEDI has participated in board meetings and provided funding for modest strategic activities that help the organization be successful. DEDI has also facilitated a number of stakeholder meetings to help explore the concept of [Property Assessed Clean Energy \(PACE\)](#) as a means of helping



# Efficiency and Conservation

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local governments provide financing to commercial property owners interested in investing in energy efficiency retrofits. These dialogues have resulted in stakeholders drafting legislation for the 2014 Kentucky General Assembly. DEDI has also worked with stakeholders to have a dialogue about considering efficiency or LEED (Leadership in Energy & Environmental Design) design for the Lexington Rupp Arena project. LEED is a program that provides third party verification of green buildings.

## Energy Codes

A key partner of DEDI is the [Department for Housing Buildings and Construction](#) (DHBC). As the principal agency charged with enforcement of the state's energy codes, its role in managing future building energy demands is huge. Everyone acknowledges that the job of code compliance is a resource-intensive job, and that DHBC is resource limited. Given that some electric utilities are capacity limited, there may be opportunities for collaboration. As such, DEDI has partnered with the [Midwest Energy Efficiency Alliance](#) to help facilitate a discussion among DHBC and the electric utilities to explore models from others states for utility-funded code compliance. Utilities in some states help fund a range of energy code-related compliance promoting activities, from code books to inspectors.

## Combined Heat and Power (CHP)

DEDI has received two grants to help promote the utilization of CHP in the state. A four-year grant of \$95,000 from the [Southeast CHP Technical Assistance Partnership](#) and another \$100,000 two-year cooperative agreement award from the U.S. DOE will help identify policies and programs that can help develop the CHP market. DEDI partnered with the [Kentucky Association of Manufacturers](#) and the [Kentucky Pollution Prevention](#)

[Center](#) to include stakeholders in the process, to educate industry on the benefits of the technology, and to provide the technical assistance needed for manufacturers and large commercial building owners to assess the application of CHP in their facilities. The project will result in a plan that spells out policies needed to make CHP more widely adopted in the state, two workshops, four facility screenings, on-site CHP feasibility analyses and other outreach activities.

## Zero Net Energy Schools

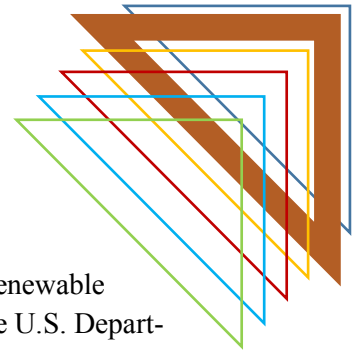
Through partnerships developed as a result of our High Performance Schools Workshop series, Kentucky has become a recognized national leader in zero net energy (ZNE) schools. Currently Kentucky has two ZNE schools and 10 ZNE-ready schools in operation. A ZNE Ready school only lacks a renewable energy source to achieve ZNE. Kentucky's ZNE schools include [Richardsville Elementary](#) and [Locust Trace AgriScience Farm](#). These schools have been showcased across the country as innovative, highly energy efficient buildings that are helping push the design threshold for school facilities and commercial buildings of the future.

## [U.S. Green Buildings Council \(USGBC\) KY Chapter](#)

DEDI continues to work with USGBC to promote better, more environmentally sustainable buildings. Chapter members are volunteering time and expertise on a year-long project at Wilmore Elementary School (Jessamine County) to conduct a LEED EB (Existing Buildings) pilot. They have also been meeting with influential leaders in Lexington to encourage the use of LEED in the proposed renovation of Rupp Arena.



# Division of Renewable Energy



**T**he Division of Renewable Energy worked with other Kentucky stakeholders this year to deliver on the Governor's goal of tripling Kentucky's renewable energy generation by providing the equivalent of 1,000 megawatts of clean energy while continuing to produce safe, abundant, and affordable, food, feed and fiber. In meeting this objective, staff primarily focused on policy development and analysis, education and outreach, and technical assistance to those pursuing renewable energy. Despite contributing only a small percentage of Kentucky's electricity generation in 2013, renewable resources produced more than 3.3 million megawatt hours. The majority of the generation is attributed to existing renewable energy capacity from hydroelectric and biomass facilities, but Kentucky did bring online new solar capacity in 2013, and a bioenergy project is in the works. Further, two utilities in Kentucky took steps to add more renewable energy to their portfolios.

Kentucky continues to see growth in the area of distributed generation with the majority of this growth occurring in the Tennessee Valley Authority's (TVA) service territory. In 2013, TVA customers added more than 2 megawatts (MW) of solar energy capacity through the TVA's Green Power Providers (GPP) program. The GPP program pays an incentive to TVA customers who generate renewable electricity, and supports 7.21 MW of distributed renewable energy. Homeowners, schools, farmers, and commercial business owners are taking advantage of this program. Projects eligible for the incentive payment include wind, solar, biomass and hydro systems rated at 50 kilowatts and below. Beyond the TVA service territory, there has also been some growth in solar capacity.

Some notable solar projects came online or under development in 2013. Fort Knox is adding 2.1 MW of

solar capacity to support renewable energy mandates set by the U.S. Department of Defense.

EEC provided a grant to Pennyrile Rural Electric Cooperative Corporation (RECC) to support what may be the largest solar array in Kentucky when it is completed. The 5 MW solar array will be built at Fort Campbell. A portion of the project is supported by a utility energy services contract arranged with Pennyrile RECC while a second portion will be built through a power purchase agreement (PPA). The project is slated to be completed in 2015.

EEC is also supporting the installation of solar photovoltaic and hot water systems at the Dishman-McGinnis Elementary School in Bowling Green. The project will provide some of the electricity and hot water for this newly constructed, energy efficient school which will be completed in 2014.

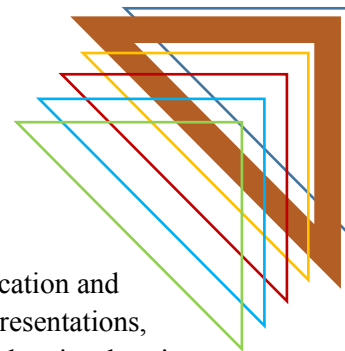
Kentucky's farmers continue to supplement their incomes with renewable energy by combining federal and state tax credits with grants and utility incentive payments. The Governor's Office of Agricultural Policy's On Farm Energy Efficiency and Renewable Energy grant program continued to provide support for re-



Solar array installed on the Garnett farm in western Kentucky

# Renewable Energy

## *continued*



newable energy in 2013. During 2013, the Governor's Office of Agricultural Policy (GOAP) approved \$1,080,000 in funding for 72 solar projects on farms in Kentucky. This program, funded partially through a grant from DEDI and from funding approved through the Kentucky Agricultural Development Fund Board, was first initiated with American Recovery and Reinvestment Act funds and has been extended using GOAP and DEDI resources.

Some Kentucky utilities have taken steps to add renewable energy to their supply mixes. In October, Louisville Gas and Electric/Kentucky Utilities (LG&E/KU) company announced plans to build a 10 MW solar array at an existing facility. If approved by the Kentucky Public Service Commission (PSC), the company's generating capacity will be one percent renewable. Additionally, the Kentucky legislature and the PSC both took action to allow the ecoPower Generation project in Perry County to move forward. Both chambers of the legislature unanimously passed Senate Bill 46, which allows the PSC to consider policy cited in the *Incentives for Energy Independence Act* as they review Power Purchase Agreements (PPAs) for biomass energy facilities. EcoPower leadership negotiated a PPA with Kentucky Power for the 58 MW facility and the PSC approved a 20-year contract that allows Kentucky Power Company to purchase the electricity from the biomass plant. The decision has been contested, and the case is pending in Franklin Circuit Court, but if the agreement is allowed to move forward it will diversify Kentucky Power's energy mix. Kentucky Power also filed a new Integrated Resource Plan with the PSC. The plan calls for the company to purchase 100 MW of wind power and add about 90 MW of solar power by 2028. The PSC will have to approve these additions of power as well.

Division staff provided education and outreach services through presentations, webinars and workshops and assisted project developers and communities by providing information about permitting, zoning, tax credits and potential partners. Wind developers are assessing a few sites in Kentucky for utility-scale wind farms. While Kentucky does not currently have wind farms, some sites may be favorable for development. Staff assist these developers and affected communities in understanding the regulatory and economic situation in Kentucky for large-scale renewable energy generation as well as the siting considerations. Provided sites are found to be favorable for development, actual construction could still be many years out.

The division provided primary staff support for the Kentucky Center for Renewable Energy Research and Environmental Stewardship (CRERES). At the end of 2012, the board began discussing the "Incentives for Energy Independence Act of 2007 Section 50 Report." This report contains several recommendations for improving energy efficiency and increasing renewable energy. Followup discussion in 2013 led the board to send letters to Governor Beshear and the PSC recommending certain actions to encourage energy efficiency and renewable energy. Recommendations included establishing standards for the evaluation of both proposed and ongoing demand side management programs and revising the net metering statutes.

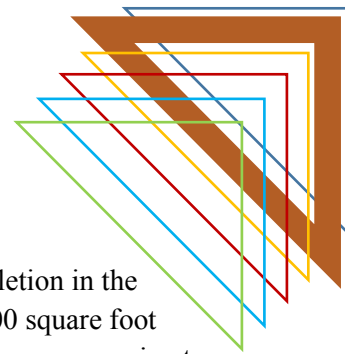
Division staff also served as liaison to the Conn Center for Renewable Energy Research at the University of Louisville. In addition to research related to the Center's core themes, the Conn Center and its partners competed at the U.S. Department of Energy Solar Decathlon 2013. DEDI was able to support construction of the Phoenix House, which was built by Team Kentuckiana and featured energy efficient building design





# Renewable Energy

## *continued*



and onsite solar electricity generation. The team included students from the University of Louisville, University of Kentucky, and Ball State University.

Details of the grants managed by the Division of Renewable Energy include the following.

### **Pennyrile RECC/ Fort Campbell Solar PV Project**

Fort Campbell will soon be home to the largest photovoltaic solar array at a military installation east of the Mississippi. Pennyrile Rural Electric Cooperative Corporation (RECC), the United States Army at Fort Campbell and EEC are partnering to develop a 5 megawatt (MW) solar array. Pennyrile RECC will be financing approximately 500 kilowatts of the array, and Fort Campbell will be entering into a power purchase agreement for the remainder. EEC awarded Pennyrile RECC a \$3.1 million grant to fund 1.3 megawatts (MW) of the 5 MW array. The total project represents an investment of more than \$19.5 million. The solar array is expected to produce approximately 6,651 megawatt-hours a year, enough electricity to power about 460 average homes. This will avoid about 4,700 tons of carbon dioxide emissions a year which is equivalent to removing 1,160 cars from the road. Design and engineering work began on the project in 2013, but the majority of the panels will be installed in 2015.

### **Bowling Green Schools Solar Project**

Bowling Green Independent School District located in western Kentucky has a long-standing commitment to energy efficient, sustainable design in the construction and operation of its school buildings. To further enhance this commitment, EEC awarded a \$33,700 grant for the Bowling Green (Independent) Schools Solar Project. This project includes the purchase and installation of a 5 kilowatt solar array and a solar hot water system at the new Dishman-McGinnis Elementary

School, scheduled for completion in the summer of 2014. The 63,000 square foot facility has been designed to use approximately 50 percent less electricity than the average school built in the area. Grant funding for this project will pay for the addition of solar photovoltaic (PV) panels, which are expected to produce about 6,000 kilowatt hours of electricity, and a solar hot water system to supply the hot water for the school's kitchen. The energy produced by these systems will avoid the purchase of about 32,500 kilowatt hours of electricity, and combined they will meet five percent of the school's energy needs. As part of the district's overall energy plan, the project will be used as a teaching tool to help students understand the role of renewable energy in meeting energy needs and reducing the environmental impact of energy consumption. Total project cost will be \$67,400.

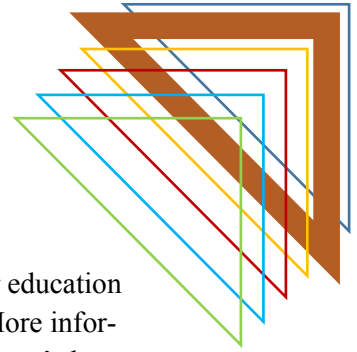


Groundbreaking ceremony for the new Dishman McGinnis Elementary school in Bowling Green.



# Renewable Energy

## *continued*



### Kentuckiana Solar Decathlon Project

The University of Louisville (UofL), in partnership with Ball State University and the University of Kentucky, known as Team Kentuckiana, was selected to compete in the U.S. DOE 2013 Solar Decathlon competition. UofL was awarded \$30,000 by DEDI in support of the project. The competition is designed to facilitate adoption of homes that demonstrate solar and

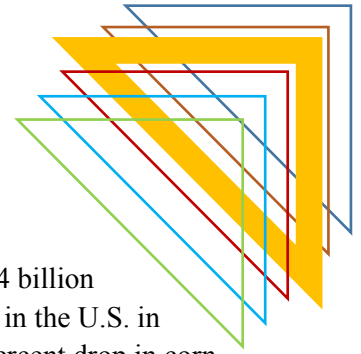
tucky and will be used for education and outreach purposes. More information on Team Kentuckiana's house can be found at the [Phoenix House](#) website or the [Solar Decathlon competition website](#).



Kate Shanks poses at the open house prior to the Phoenix House being transported to the competition.

energy efficiency technologies in marketable applications, while developing excellence in building science education at the university level. The Kentuckiana project was named Phoenix House and was designed to be a permanent and sustainable post-disaster housing prototype that can be quickly deployed for families that have lost their homes to disaster. The competition was held in October 2013 at Orange County Great Park, Irvine, Calif. with 19 other universities taking part. Each home was evaluated on 10 separate criteria and Team Kentuckiana ranked 15<sup>th</sup> in the overall competition. The house was transported back to Ken-

# Division of Biofuels



**T**he mission of the Division of Biofuels is to provide leadership to grow Kentucky's biofuels and biomass industries through research, development and commercialization while continuing to produce safe, abundant and affordable food, feed, and fiber. Division staff worked toward achieving the Governor's goal that by 2025, Kentucky will derive 12 percent of its motor fuels demand from biofuels. Based upon U.S. Energy Information Administration data, Kentucky's ethanol consumption relative to motor gasoline use has increased from 8.49 percent in 2008 to 9.7 percent in 2012. Data are not available to identify the percent of biodiesel consumed in Kentucky, but there is currently 68 million gallons of production capacity in the state. Over 1 billion gallons of biodiesel was produced in the U.S. during 2013. While around 10 percent of this production was exported, the biodiesel consumed represented about 2 percent of our domestic diesel usage. Diesel fuel sold in Kentucky may contain up to 5 percent biodiesel without being labeled. A few stations in Kentucky offer biodiesel blends of up to 20 percent.

Federal policy debate continued to dominate the bioenergy sector's future in 2013. Issues ranged from the United States Environmental Protection Agency's (EPA) treatment of biogenic CO<sub>2</sub> emissions, Congress's inability to pass the Farm Bill and EPA announcing plans to considerably reduce the Renewable Volume Obligation for advanced biofuels in 2014.

Even as Washington created a challenging environment for the renewable fuels industry in 2013, the weather was much more amenable and enabled Kentucky farmers to join much of the nation in producing record crops. Based upon the latest United States Department of Agriculture estimates, the average corn yield in Kentucky jumped from 68 bushels per acre in 2012 to

173 in 2013. The nearly 14 billion bushel corn crop produced in the U.S. in 2013 has facilitated a 40 percent drop in corn prices, has enabled a number of idled ethanol plants to restart production, and has helped reduce the price of ethanol substantially below the price of gasoline. While no stations are currently offering E15 in Kentucky, motorists with flex fuel vehicles can fill up with E85 at one of more than 50 locations offering the fuel. To increase the number of E85 stations, the Kentucky Corn Promotion Council offered petroleum retailers \$5,000 grants throughout 2013 to install the E85 pumps.

The Kentucky Soybean Promotion Board (KSPB) also took an active role in helping improve biofuel awareness by sponsoring training for diesel technology instructors at their summer conference in Louisville. The teachers were provided an overview of a biodiesel curriculum that was developed in Iowa and accredited by the National Automotive Technician Education Foundation. The KSPB also provided certificates and awards to students enrolled in the Kentucky Community and Technical College System diesel programs who successfully completed the training at their respective schools.

Recast Energy, a biomass thermal facility in Louisville, became fully operational after completing its transition from coal to woody biomass early in the year. The project is utilizing more than 75,000 tons of waste wood annually from the region to provide steam for its two industrial customers. The firm hosted tours at the plant for attendees of two national energy and forestry conferences meeting in Louisville. The plant leadership stressed the importance of educating their suppliers on keeping dirt and other foreign matter out of the wood they deliver to these types of operations.



# Biofuels

## *continued*



Recast Energy facility tour, Louisville, Kentucky

The Kentucky legislature and the Kentucky Public Service Commission (PSC) both took actions that allowed the proposed ecoPower Generation project in Perry County to make progress. See page 15 for more details.

Researchers at the University of Kentucky College of Agriculture published their final report on the switchgrass initiative involving farmers in northeast Kentucky and East Kentucky Power Cooperative (EKPC) in February. The effort was started in 2007 with funding from the Kentucky Agricultural Development Fund and was extended in part by stimulus funds channeled through the Energy and Environment Cabinet. Due to a number of policy uncertainties, unforeseen low natural gas prices, and other hurdles, it is unlikely that EKPC is moving forward in the near future with switchgrass combustion. The research, however, addressed a number of agronomic, economic and logistical issues that will assist future forage production and bioenergy efforts. The complete report - [\*Farm Scale Biomass Production for Electricity Generation and Community Development\*](#) can be accessed at DEDI's website.

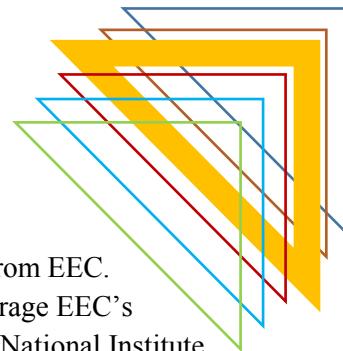
Division staff remain actively engaged in networking with community leadership, research teams, economic development personnel, and commercial firms to foster additional investment in the state. Staff were invited to moderate a panel discussion at the International Biomass Conference entitled *The Importance of Building Community and Stakeholder Support in the Bioenergy Sector*. Additionally, staff presented a poster on Kentucky's resource potential for bioenergy projects at the Industrial Biotechnology Organization's World Congress and addressed attendees at the annual Energy Biosciences Institute hosted by the University of Illinois. DEDI is involved with biomass presenter planning with the Kentucky Association of Manufacturer's Energy Conference and the Kentucky Association for Economic Development's Annual Meeting.

Significant progress was made in 2013 by a number of commercial advanced biofuel firms in the United States and around the world. Beta Renewables commissioned their 20 million gallon cellulosic ethanol plant in Italy, showcased the fully operational facility to international visitors in October, and announced future projects in North Carolina, California, and other countries. Ineos Bio began commercial production of ethanol from waste streams in Florida at its 8 million gallon facility in July. KiOR is still working through some operational challenges, but has been producing renewable gasoline and diesel from woody biomass at their commercial plant in Mississippi. DuPont, Abengoa, Poet-DSM, and Cool Planet Energy Systems are all at varying stages of construction on U.S. based advanced biofuel facilities scheduled to be operational in 2014. Division staff have remained in contact with a number of these firms to determine project prerequisites and identify potential sites in the state.



# Biofuels

## *continued*



Future bioenergy investment opportunities for Kentucky will depend primarily on the financial viability of the commercial projects currently operating and under construction. If the existing technologies are profitable and/or the investment community senses the success can be replicated and enhanced with future advancements, our state has vast resources and attributes for a role in this industry.

Specific grants managed by the Division of Biofuels include the following.

### **West Kentucky Bio-Energy Demonstration Center at Murray State University**

Murray State University (MSU) is developing the West Kentucky Bio-Energy Demonstration Center at the MSU Equine Farm to explore biomass options to produce clean energy. The Center will include two BB500 Bio Burner units manufactured in Kentucky, a screening system to remove excess hay, and a building enclosure for both units. One of the two units at the equine center will be mobile and used for off-site demonstration purposes. MSU will also purchase a drying unit and pelletizer machine. These machines will be added to the existing burner components and allow for additional research and demonstrations on the uses of biomass.

This project will demonstrate how cost-effective bioenergy applications can supplant traditional heating systems. MSU will also conduct emission testing of the bioenergy units for air quality compliance. The units will provide radiant heat to the equine center and will offset fossil fuel energy with renewable energy at a rate of 40,000 kWh to 50,000 kWh per year. The primary biomass for the units will consist of muck or bedding material from horse stalls. Each unit will have the capacity of producing 500,000 btu per hour of renewable energy. Total project costs will be more than \$618,000

with the \$309,000 match from EEC. MSU was also able to leverage EEC's support to secure a USDA National Institute of Food and Agriculture grant to further the efforts of the West Kentucky AgBioworks initiative. While significant progress was made on the development of the project in 2013, a number of unforeseen issues have delayed the ability to use the equipment for heating the facility until next winter.

### **Energy from Hatchery Waste at Perdue Farms, Incorporated**

Perdue Farms, Incorporated developed an integrated waste recovery process at their poultry facility in Cromwell, Ky. that utilizes discarded materials from their hatchery. Newly installed equipment will recover the organic waste from spent eggs that did not hatch, eggs that could not be used, and other high organic wastes. The protein and water mixture is being delivered to an anaerobic pond that has been producing bio-



Dr. Brannon of MSU observes the unit at a field day demonstration.

gas for conversion to electricity and heat at their processing facility. Cleaned and finely ground egg shells will be stockpiled and land applied as a soil amendment. The project should generate 620,000 kwh of



# Biofuels

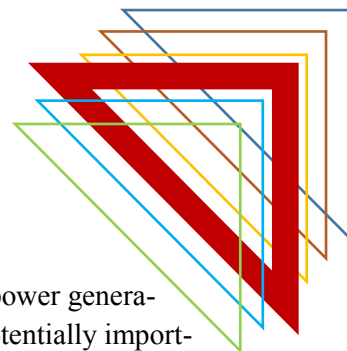
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power and avoid burning 2,506 decatherms of natural gas annually. Additional environmental benefits of the project will result in the diversion of an estimated 1,500 tons of organic waste from the Ohio County landfill annually. Total project costs were more than \$290,000 with the EEC committing \$145,000 in matching funds. Perdue is working closely with researchers at the USDA Animal Waste Research unit in Bowling Green to improve the efficiency of their waste to energy efforts and enhance the deployment of these technologies for other applications.

John Devinney with Perdue  
uncrating the new egg crushing  
equipment



# Division of Fossil Energy Development



The division's mission is to provide leadership to maximize the benefits of Kentucky's energy resources in a clean and sustainable manner while creating a base for strong economic growth and fostering national energy independence and security. The Division has oversight to implement fossil energy initiatives in Kentucky that includes, but is not limited to, coal-to-gas, coal-to-liquids, compressed natural gas and liquefied natural gas. For several years, the division maintained a special area of interest for waste-to-energy initiatives but those efforts proved too challenging given current market conditions and the division has refocused its efforts toward fossil energy initiatives. Additionally, division staff helped to educate Kentucky stakeholders about developing natural gas as a transportation fuel. This assistance has resulted in increasing the number of natural gas refueling stations in the Commonwealth.

Division staff spent the majority of the year overseeing energy research and public education on coal. Initiatives managed by the staff are highlighted below.

## ***Energy Research Projects***

### **Optimization of Conversion Kinetics of Kentucky Coals in an Integrated Process for Flexible Syngas Production.**

Western Kentucky University WKU was awarded \$200,000 for the research and development of a novel coal utilization process, integrating the partial gasification of coal in the chemical looping and combustion of the rest char residue. This process concept adapts widely to different following-up coal processes, such as coal-to-liquid (CTL) and coal-to-gas (CTG) and retrofitting for the current aged coal combustion utilities. This new process could be an initial step of CTL and CTG for syngas supply, and also an initial step of the aged coal-power utilities for their capacity retrofitting and ef-

iciency improvement of power generation. CTG and CTL are potentially important new markets for coal that support the coal economy while bolstering energy independence. Chemical looping combustion is a process for extracting coal's energy while reducing the impact of CO<sub>2</sub> from coal combustion. Both topics are essential to Kentucky's future economy and energy production.

### **Advanced Development and Assessment of Innovative HM Cyclone Separation Technology for High Efficiency Coal Cleaning**

Advanced Particle Separation Technology, LLC (APST), was awarded \$254,268 to research the development and assessment of innovative cyclone separation technology for high efficiency coal cleaning. The new cyclone technology and design promises lower cost, better efficiency, less waste, and higher quality in the coal cleaning process required as a precursor to burning coal for electricity. APST is to build a pilot scale system and test it for the design parameters necessary for a full-scale system. The total economic benefits of the improved coal washing technology are estimated to be more than \$600 million per year for Kentucky. A better route to cleaned coal is beneficial to coal-burning utilities seeking to gain the most power from the coal. This efficiency helps keep costs of electricity as low as possible.

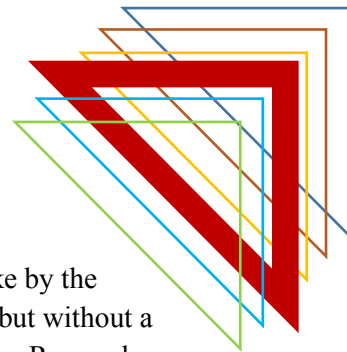
### **Remediation of Coal Slurry Impoundment Liquids Using a Multi-Stage Constructed Treatment Wetland System**

The University Of Kentucky College Of Agriculture was awarded \$61,355 to develop a novel and cost effective approach that can be used by the coal industry to reduce the burdens associated with controlling the movement and quality of liquids from surface impoundments and storage ponds, using constructed treat-



# Fossil Energy Development

## *continued*



ment wetlands. Achievement of this goal would improve the long-term economic and environmental sustainability of coal production in the Commonwealth. A pilot-scale, multi-celled treatment wetland system is to be constructed at the University Research farm. Liquid obtained from a working slurry pond will be circulated in the constructed wetland system to determine parameters for design and operation of a full-scale system. A constructed wetland treatment is potentially an economical and efficient way to reduce the potential pollution and health risk from surface impoundments and storage ponds. The constructed wetland will provide treatment of contaminants before they are released to the waters of the Commonwealth.

### **Modern Rock Dust**

The University of Kentucky Department for Mining Engineering (UKDME) was awarded \$364,011 to evaluate current technology for rock dust dispersion in underground coal mines. Several new technologies are emerging onto the market and need to be evaluated for inerting performance in coal dust applications. Project objectives include evaluating the flame-front extinguishing performance of the new technologies developed by the project team and independent companies against typical dry-dust and wet-dust applications, and comparing cost of each newer rock dusting process with typical dry or wet dust applications. An explosion in a coal mine is made worse by coal dust that readily and rapidly burns. When rock dust is intentionally added to the mine environment, it reduces the effect of coal dust and helps suppress the explosive effects.

### **Anode Coke from Coal**

The University of Kentucky Center for Applied Energy Research (UK CAER) was awarded \$163,565 for a proof of concept study to examine the feasibility of

producing anode grade coke by the solvent extraction of coal, but without a costly solids separation step. Researchers will select suitable high volatile A coals from the East Kentucky coalfield (e.g. Knox and Whitley counties) and determine whether the process can be adapted to provide an economically viable alternative for producing anode-grade coke. Western Kentucky primary aluminum producers located in Henderson and Hancock counties have expressed interest in the project and have provided support. Coke is a form of carbon that is essential to making stainless steel and aluminum. It is derived from very high-grade coal. A process for converting lower-grade coal the coke will be beneficial for both the mining and metals industries.

### **Underground Coal Laboratory**

UKDME was awarded \$350,000 in 2012 to study the feasibility of and initiate a preliminary design for an underground coal laboratory. The project has continued through 2013 with on-going activities in data collection, facility design, and site selection. Completion of the documentation "Final Packaging and Reporting," including facility design and costing is scheduled for the end of 2013. The benefit of the underground laboratory is for researchers to better simulate actual mine environments and develop better and safer mining techniques.

### **University of Kentucky Chemical Looping**

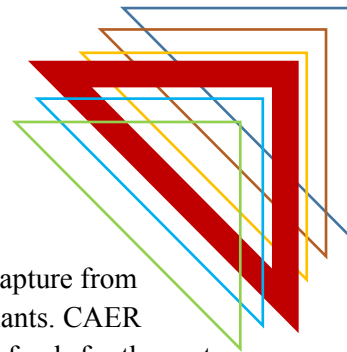
UK CAER was awarded \$178,049 for research of coal-fueled pressurized chemical looping combustion (PCLC) combined cycle for power generation and CO<sub>2</sub> capture. This project is targeting development of an advanced technology to burn coal with in-situ CO<sub>2</sub> capture for baseload power generation based on the chemical looping combustion concept and providing a





# Fossil Energy Development

## *continued*



pathway to maintain and strengthen coal's competitive advantage for Kentucky's energy sector. The potential positive impacts from the PCLC for large scale power generation include (1) provision of a higher-efficiency alternate technology for electricity generation with CO<sub>2</sub> capture; (2) a cost-effective means to control pollutants; (3) cleaner flue gas; and (4) significant reduction in cost of electricity of a commercialized CLC power plant.

### **University of Kentucky CO<sub>2</sub> Capture Regeneration**

UK CAER was awarded \$203,344 for research on efficiency improvement in CO<sub>2</sub> capture solvent regeneration using a load leveling electricity to thermal energy absorption strategy. The project provides an energy absorption and release technology that can be directly applied to coal, post-combustion CO<sub>2</sub> capture power plants. The proposed technology improves power plant efficiency by load leveling, reducing cost and energy demand for the CO<sub>2</sub> capture process. Load leveling enables optimal base load plant efficiency at all times. It is a technology that returns excess energy produced during valley demand back to the plant as thermal energy during peak demand. As coal-burning utilities are increasingly required to reduce greenhouse gas emissions through CO<sub>2</sub> capture, new research projects like this one will reduce the cost and maintain delivery of electricity.

### **University of Kentucky Carbon Management Research Group**

UK CAER was awarded \$2,650,000 in 2012 for the Carbon Management Research Group (CMRG) and support for a U.S. DOE cooperative agreement ["Application of a Heat Integrated Post-combustion CO<sub>2</sub> Capture System with Hitachi Advanced Solvent into Existing Coal-fired Power Plant"](#). CMRG is a consortium of industry, government and university entities sup-

porting research into CO<sub>2</sub> capture from existing coal-fired utility plants. CAER uses the award as matching funds for the cost-share requirement to the \$14 million DOE cooperative agreement. The project will involve the design, fabrication, installation, testing, and analysis of a slipstream facility located at LG&E-KU's E.W. Brown Generating Station to demonstrate an innovative carbon capture system that utilizes heat integration with the main power plant. Success of this project will advance the commercialization and economy of CO<sub>2</sub> capture as a means for reducing greenhouse gas emissions from coal-burning power plants. This project will help make existing coal-burning plants viable and new ones feasible in the future.

### **University of Kentucky Algae Project**

UK CAER was awarded \$531,409 to continue a current project designed to demonstrate an Algae-Based System for CO<sub>2</sub> Mitigation from Coal-Fired Power Plants. The project is focused on the design, construction, and demonstration of an algae-based CO<sub>2</sub> mitigation process suitable for use at Kentucky power plants. The overall goal of this project is to design a process

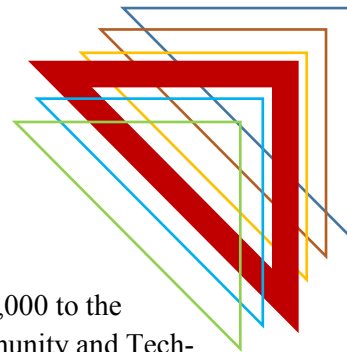


Photo-bioreactor system utilizing algae for the conversion of power plant emissions into beneficial products



# Fossil Energy Development

## *continued*



capable of utilizing the flue gas through operation of a continuous microalgae culture, harvesting a sustainable quantity of the algae, and converting harvested algae into a value-added product (e.g., fuel for co-firing, bio-oil for conversion to biodiesel, bio-gas, or a nutritional additive for animal feed). Efforts to date have resulted in the development of a low-cost, closed-loop photobioreactor. The system was scaled-up to slip-stream size and installed at the Duke Energy East Bend station for actual field testing. The CAER-developed algae photobioreactor is a unique technology for capturing CO<sub>2</sub> from coal-burning utility flue gas and harvesting a useful bio-fuel from the algae. Successful commercialization of the process could be very beneficial to existing and potential new coal-burning power plants.

### **Eastern Kentucky University Low-cost Biomass to Biofuels**

Eastern Kentucky University was awarded \$123,662 for research on a novel approach to acquire sugars from biomass in order to provide a feedstock for biofuels that rely on microbial fermentation such as ethanol and algae. Biomass is a bioenergy source that is relatively abundant in eastern Kentucky that utilizes forestry residues and less productive land (post-mine sites). Biomass derived biofuels potentially reduce competition between biofuels and food, provides local employment and stimulates rural economies.

### ***Public Education on Coal Related Issues (KRS 132.020(5))***

#### **Kentucky Coal Museum and Portal 31**

The Kentucky Coal Museum and Portal 31 provide education on coal and coal mining activities to the public by allowing access to one of the most comprehensive collections of mining information and memorabilia in the nation.

In 2013 EEC awarded \$60,000 to the Southeast Kentucky Community and Technical College (SKTC) for management of the museum's and portal's activities. SKTC uses story boarding and interpretive signage to enhance the educational experience for visitors of the [Kentucky Coal Museum and Portal 31 Exhibition Mine](#). The grant also funds a percentage of salaries and benefits for the museum curator and assistant curator. The goal of the project is to improve the visitor experience by enriching discussion, broadening understanding, clarifying perceptions and sharpening observation of details. With a focus on coal mining and the community culture of coal mining families, this project significantly increases the museum and portal's ability to educate visitors about this important energy resource, its history, industry and people, in Kentucky and the nation.

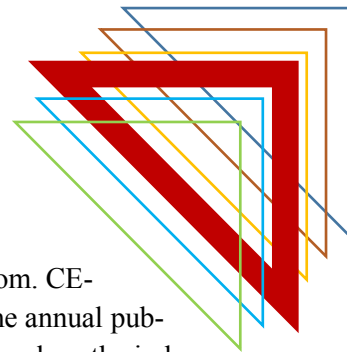
### **Coal Education Development and Resources (CEDAR, Inc.) East Kentucky Coal Education Project**

[CEDAR, Inc.](#) was awarded \$65,000 by EEC to continue its coal education programs for K-12 school children in 15 Eastern Kentucky coal counties. Among several program initiatives of CEDAR, Inc., three illustrate the scope of the organization's activities. Through the CEDAR Coal Study Unit (CSU) Program, teachers have the opportunity to use their skills in creating, developing, and implementing a Study Unit (lesson plan) on an array of topics involving coal. The CEDAR Coal Fair Program provides students the opportunity to investigate certain aspects of coal and apply their findings to showcase their talent and knowledge by creating a coal project and entering it in one of seven subject categories. Through a partnership with the [Challenger Learning Center](#) (CLC) in Hazard, CEDAR offers a fourth grade program known as Mars Invasion 2030 – From Coal Camp to Space Camp. This program



# Fossil Energy Development

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provides students the opportunity to discover the similarities between space science and coal mining, as well as those of the job skills required to be either an astronaut or coal miner.

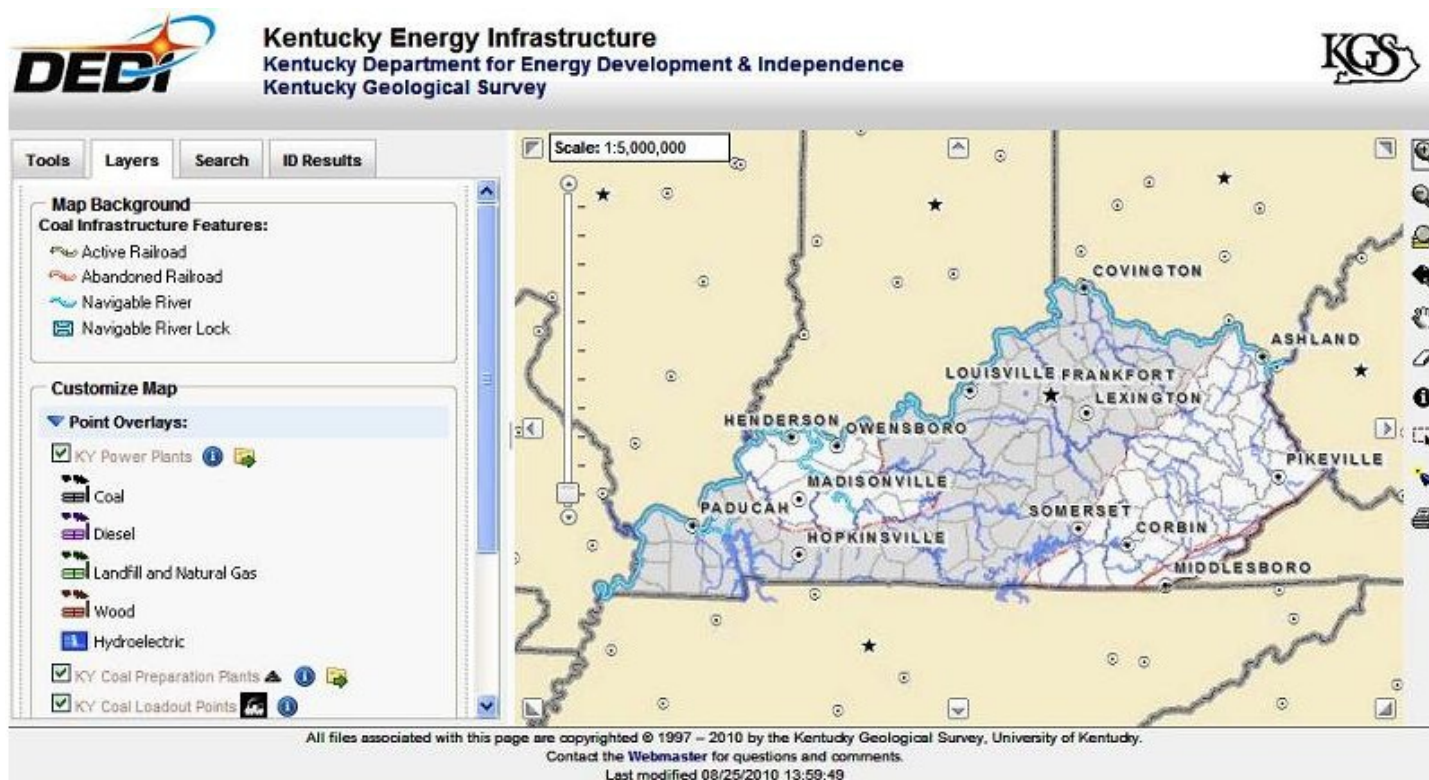
### **CEDAR West, Inc.: Western Kentucky Coal Education Programs**

EEC awarded [CEDAR West, Inc.](#) \$40,000 to offer coal education programs in six western Kentucky coal counties. CEDAR West, Inc. is in its 18th year of implementing coal education programs that stress the importance of coal to the citizens of Kentucky. The program provides an avenue of learning about the history of coal, the economic contributions that coal provides in meeting Kentucky's energy demands, and the energy demands of our nation. CEDAR West provides teachers in the region a "Coal Education Packet" containing sample coal education materials. From this packet they develop an idea for a coal study unit to be

implemented in the classroom. CEDAR West also conducts the annual public coal fair. The coal fair involves the judging of K-12 student entries in the following academic categories: science, math, language arts, music, art, and technology.

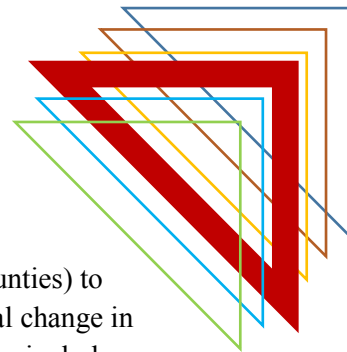
### **Kentucky Coal Resource Information**

The Kentucky Geological Survey (KGS) created a new web-based mapping service that places Kentucky coal resource information in a geographical visualization environment. EEC supported this effort by awarding a \$39,300 grant to KGS. The purpose of the website is to show the magnitude and geographic distribution of coal resources with potential for future development. Estimates of remaining coal shown on this site are believed to be an available resource, but no analysis has been done to determine whether the deposits are economically recoverable under specific market conditions



# Fossil Energy Development

## *continued*



or if there may be other restrictions to mining. Previous studies of coal availability and recoverability suggest that between 20 percent and 50 percent of remaining coal may be economically recoverable. [The Kentucky Coal Resource Information website](#) became accessible in August.

### University Energy Clubs

The University of Kentucky's Center for Applied Energy Research (CAER) was awarded \$30,000 to continue the sponsorship of the University Energy Clubs. CAER will continue the existing Energy Club programs in addition to incorporating workforce development initiatives and inter-club project(s) involving all of the existing and future Energy Clubs. The club structure encourages membership within all major areas of study, resulting in the education of students pursuing a wide variety of career paths. In a collaborative effort between the CAER facilitator and the club members and advisors, energy-related opportunities will be organized and in some cases hosted by clubs. Such activities will include lectures, site tours, round table events, and attendance at energy-related conferences. Energy Clubs are a strong extracurricular activity that inform future decision-makers about the issues and opportunities of Kentucky's energy resources and applications. They encourage and stimulate interest in Kentucky energy careers.

### **Bluegrass Greensource Coal Education**

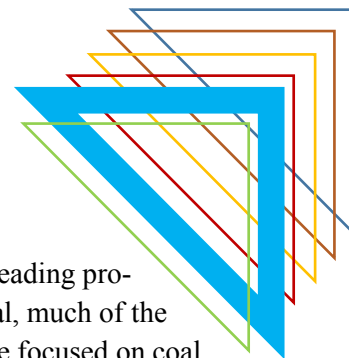
Bluegrass Greensource was awarded \$50,000 to continue coal education initiatives throughout central Kentucky. Bluegrass Greensource (formerly Bluegrass PRIDE) is an environmental nonprofit that provides resources and education to empower residents of its service area (Anderson, Bourbon, Boyle, Clark, Estill, Fayette, Franklin, Garrard, Harrison, Jessamine, Lincoln, Madison, Mercer, Montgomery, Nicholas, Pow-

ell, Scott and Woodford Counties) to foster positive environmental change in their communities. Activities include an energy tour for teachers, experiential education in classrooms, energy tours for K-12 students, and energy-related careers tour for postsecondary students. Providing deeper and broader education about all aspects of energy in Kentucky prepares students for positive energy engagement in the future. Students visited the UK Center for Applied Energy Research to learn about coal research and development in Kentucky, as well as toured coal power plants to understand how coal is used in the Commonwealth.



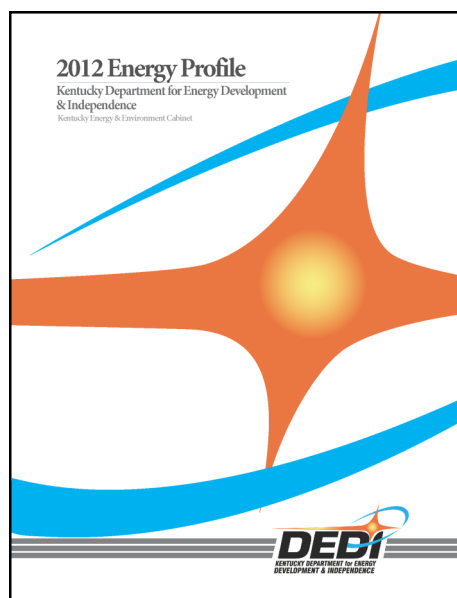


# Division of Carbon Management and Data Analysis

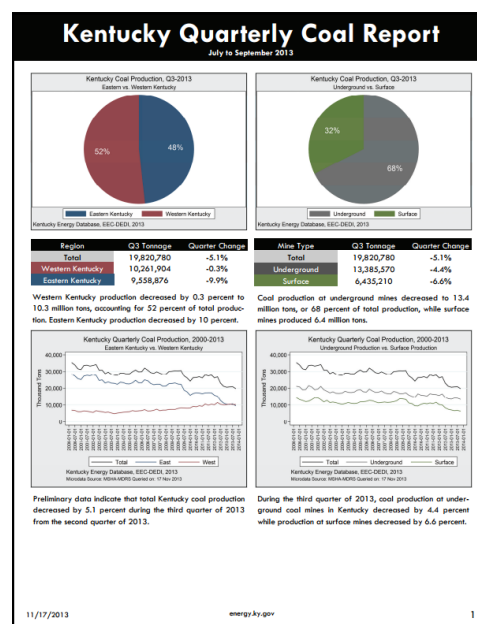


The Division of Carbon Management and Data Analysis investigates, develops, and promotes technical solutions for carbon capture, storage and reuse; and engages with state, regional and federal agencies in the development of state policy designed to manage greenhouse gas emissions, especially carbon dioxide. Additionally, the division is responsible for energy data collection, storage and analysis for the department. The division's goal is to evaluate and deploy technologies for carbon management with use in 50 percent of Kentucky's coal-based applications by 2025.

In 2013, division staff collected, stored, analyzed, and published data on Kentucky energy production and consumption. This information is used to promote efficient energy markets, sound policymaking, and better public understanding of energy and its interaction with the environment and economy in the Commonwealth. Staff graphically summarized these databases with maps and charts in the [Kentucky Energy Profile](#), which served as an impartial point of reference for the general public, researchers and policy makers.



Since Kentucky is both a leading producer and consumer of coal, much of the division's data analyses are focused on coal. Division staff tracked coal production, employment, prices, chemical composition, as well as all shipments of coal to and from Kentucky. These data on Kentucky coal are summarized in the annual publication of the [Kentucky Coal Facts](#). However, in light of the rapid changes underway in Kentucky coal markets in 2013, division staff were asked to also begin publishing the [Kentucky Quarterly Coal Report](#) to provide leadership and the general public with current coal production and employment statistics.

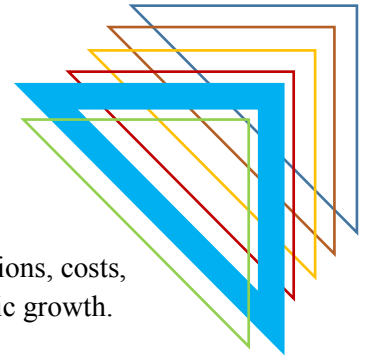


Databases and data-related publications also support the Commonwealth Energy Assurance Plan. This plan identifies potential threats to the energy security of the Commonwealth, and facilitates the restoration of energy supplies in the event of an emergency.

The division's comprehensive databases are made possible through partnerships with the Kentucky Depart-

# Carbon Management and Data Analysis

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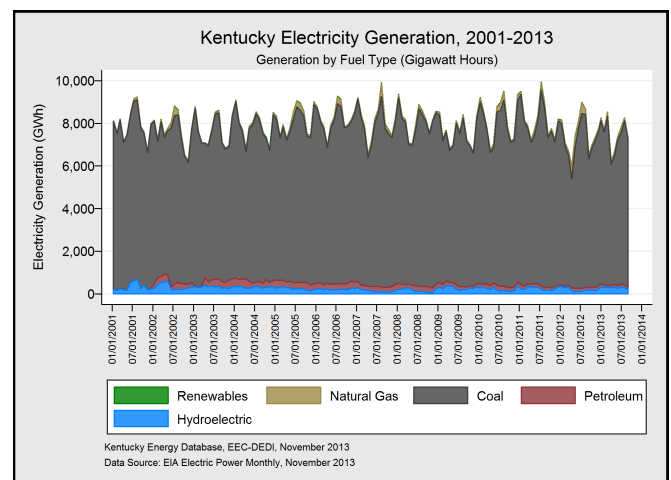
ment of Natural Resources, Kentucky Department for Environmental Protection, Kentucky Geologic Survey, Kentucky Coal Association, United States Department of Energy, and Mine Safety Health Administration.

Through contracts with the National Association for State Energy Officials (NASEO) and the [Southern States Energy Board](#) (SSEB) over the past two years, the division has also provided customized energy data publications for 20 other states.

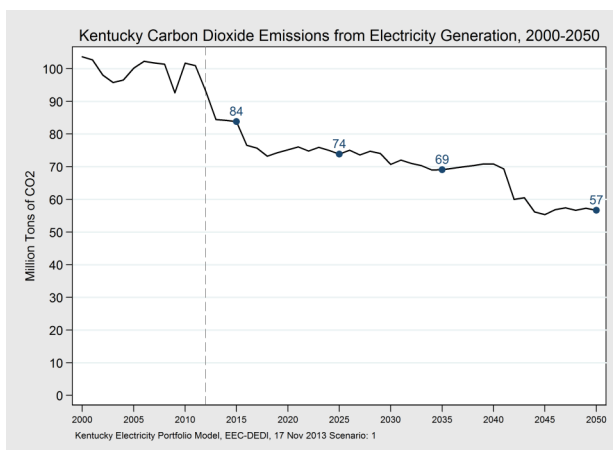
In 2013, division staff used this in-house modeling capacity to estimate the potential implications federal greenhouse gas emissions reduction targets could have on Kentucky electricity prices, fuel consumption, employment, and economic growth. The cabinet partnered with the University of Kentucky Department of Statistics, University of Kentucky Center for Applied Energy Research, and Pacific Northwest National Laboratory to determine the electricity generation technology options available to Kentucky. The model identified the least-cost means of complying with potential federal environmental regulations and then simulated building and operating that generating portfolio. The report, entitled the “[Economic Challenges Facing Kentucky’s Electricity Generation Under Greenhouse Gas Constraints](#),” summarizes Kentucky electricity demand,

generation technology options, costs, employment, and economic growth.

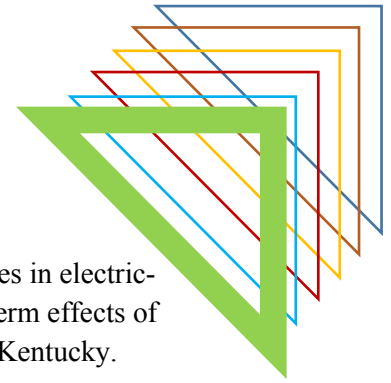
While the model is intended for policy analysis, it has also been valuable for educational purposes in various public events and university classrooms where people have been invited to interact with Kentucky’s simulated electricity portfolio. During these opportunities, users discover the challenges of reducing greenhouse gas emissions without raising energy costs.



DEDI leverages its national database of energy, environmental, and related socioeconomic factors to build and calibrate predictive energy models customized for Kentucky to help the public and policy makers plan for the future.



# Division of Generation, Transmission and Distribution



**T**he primary responsibilities of the Division are to analyze and develop policies that will facilitate the generation, transmission, and distribution of secure, adequate, affordable, and clean energy within the Commonwealth. Division staff also work to understand the economic tradeoffs for baseload electricity generation alternatives and to identify policies that will ensure adequate transmission and distribution of energy resources. Additionally, staff have the responsibility for initiating research and promoting discussion on all generating technologies and energy strategies.

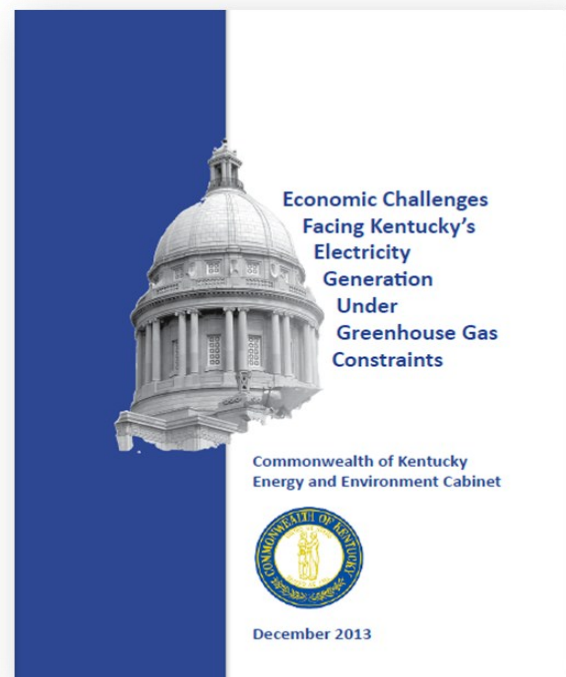
During 2013, staff updated Kentucky's Energy Assurance Plan and submitted that plan to the U.S. DOE. The plan provides a roadmap to respond to and recover from an energy emergency. Staff participated in emergency situation training exercises and convened the Kentucky Energy Resources Management Board for training.

Staff continue to monitor changes in environmental regulations affecting the mining and transportation of coal, natural gas, and other petroleum liquids as well as electricity production and overall energy prices. Pending changes will continue to have significant impacts on how energy is produced and priced in Kentucky. Equally important will be the effects of environmental regulations on Kentucky's energy intensive industrial base and overall economy. Of particular concern is the possibility of the Environmental Protection Agency regulating CO<sub>2</sub> and other greenhouse gas emissions from fossil fueled electric power plants. The particular form these regulations take and the speed with which they are implemented may have profound effects upon Kentucky's economy. Division staff continue to use recently enhanced electricity price forecasting software developed by DEDI to eval-

uate the potential changes in electricity prices and the long term effects of those price changes for Kentucky.

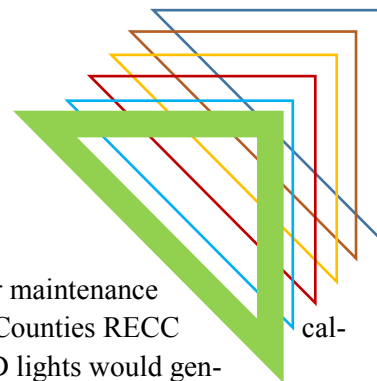
Division staff represented the Governor's office on the Eastern Interconnection States Planning Council (EISPC). The EISPC is a collaboration between state utility commissions and governors' offices of the states east of the Rocky Mountains, organized to direct the analysis of electricity system plans for the Eastern Electricity Interconnection. The result of this collaboration will be the identification of additional interstate transmission corridors.

Working in collaboration with Pacific Northwest National Laboratories, and both the University of Kentucky's Center for Applied Energy Research and Department of Statistics, division staff contributed to the research and development of the "Economic Challenges Facing Kentucky's Electricity Generation Under Greenhouse Gas Constraints" report. This was a com-

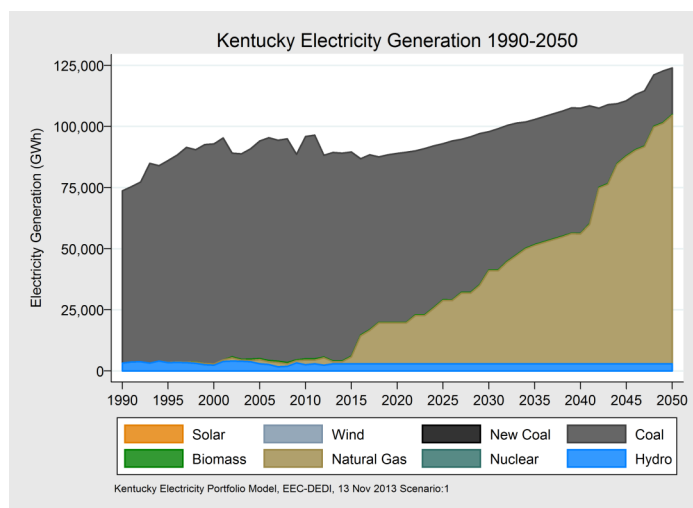


# Generation, Transmission and Distribution

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panion study to an earlier whitepaper, “Greenhouse Gas Policy Implications for Kentucky under Section 111(d) of the Clean Air Act.” The report explains that depending on how EPA implements CO<sub>2</sub> constraints the impacts on the Kentucky’s economy will significantly vary. The report also found that how Kentucky reacts to federally imposed CO<sub>2</sub> regulations can lessen or exacerbate the effects of the constraints. The report found that if CO<sub>2</sub> constraints are imposed, electricity price increases and lost employment opportunities will occur.



The division also managed the following grants.

### **Outdoor Lighting Energy Efficiency Project**

In response to an EEC grant solicitation Hickman – Fulton Counties Rural Electric Cooperative Corporation (RECC) submitted a proposal to replace 1,715 of its inefficient outdoor lighting fixtures with energy efficient LED fixtures throughout its service territory in Hickman, Fulton, Carlisle and Graves counties. The total cost of the project was estimated to be \$652,000. EEC awarded a matching grant for \$316,000 toward the project in April 2013. The replacement LED lights are projected to have a 20 year

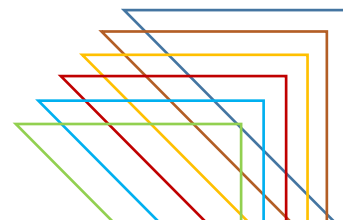
life and 50 percent lower maintenance costs. Hickman-Fulton Counties RECC calculated that the new LED lights would generate 40 - 60 percent energy cost reductions, which equates to annual savings of more than 194 kW, 852,117 kWh and reduced the company’s power bill by \$49,298. The energy savings equates to approximately 919 pounds of nitrogen oxide, 2,904 pounds of sulfur dioxide and 1.2 tons of carbon dioxide. Hickman-Fulton Counties RECC completed the project in November.

### **Kentucky-Argonne Battery Manufacturing Research and Development Center**

Funded by EEC beginning in 2012, a contract was awarded to TRK for support and advancement of the [Kentucky Argonne Battery Manufacturing Research and Development Center](#) (Center). TRK was tasked to create and implement a plan to support the Center and develop industry and government partnerships. The Center is a multi-institutional, interdisciplinary, non-profit collaboration established to support the development of advanced battery manufacturing technologies of the next decade and beyond. The Center’s mission is to provide a full-service research and development capability for industry, universities and government to enable competitive domestic manufacturing for advanced batteries. Current partnerships include University of Kentucky, University of Louisville and U.S. DOE Argonne National Laboratory.



# Appendix A—Summary of Grant Awards

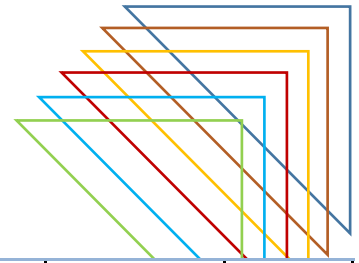


Grant Award	Recipient	Start	End	Grant Award Dollars	Matching Amount Dollars	Total Project Dollars	Page
Algae Carbon Capture Research	University of Kentucky	11/15/2013	12/31/2013	531,409	230,710	762,119	24
Anode Coke from Coal	University of Kentucky	5/1/2013	6/30/2014	163,565	22,148	185,713	23
Bioenergy Demonstration Center	Murray State University	4/15/2013	12/31/2015	309,000	309,000	618,000	20
Biogas to Fuel Renewable Energy from Hatchery Waste	Perdue, Inc.	4/15/2013	12/31/2015	145,000	145,000	290,000	20
Bowling Green Solar Project	Bowling Green Public Schools	4/1/2013	12/31/2015	33,721	33,721	67,442	16
Carbon Management Research Group	University of Kentucky	7/1/2012	6/30/2014	2,583,291	2,000,000	4,650,000	24
Chemical Looping	University of Kentucky	7/1/2013	6/30/2014	178,049	19,648	197,697	23
CO2 Capture Regeneration	University of Kentucky	5/1/2013	6/30/2014	203,344	33,416	236,760	24
Coal Ed Programs	Bluegrass Green-source	7/1/2013	6/30/2014	50,000	—	50,000	27
Coal Ed Programs	CEDAR, Inc.	7/1/2013	6/30/2014	65,000	—	65,000	25
Coal Ed Programs	CEDAR West	7/1/2013	6/30/2014	40,000	—	40,000	26
Coal Museum & Portal 31	Southeast Kentucky Community & Technical College	7/1/2013	6/30/2014	60,000	110,290.50	170,290.50	25
Coal Slurry Remediation	University of Kentucky	5/1/2013	6/30/2014	61,355	34,158	95,513	22
Conversion Kinetics Syngas Production	Western Kentucky University	7/1/2013	6/30/2014	200,000	200,000	400,000	22
Cooperative Extension Energy Associate	University of Kentucky	7/1/2013	6/30/2014	100,000	—	100,000	12
Cyclone Coal Cleaning	APST, LLC	3/15/2013	6/30/2014	254,268	284,163	538,431	22



# Appendix A—Summary of Grant Awards

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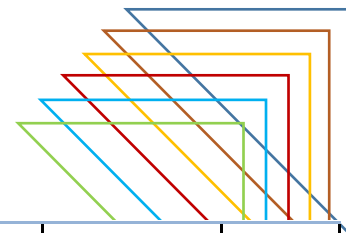


Grant Award	Recipient	Start	End	Grant Award Dollars	Matching Amount Dollars	Total Project Dollars	Page
Electric Generation Unit Efficiency Study	Pacific Northwest National Laboratory	7/1/2013	12/31/2013	249,970	—	249,970	30
Energy Efficiency & Conservation for Local Governments	Kentucky Department for Local Government	4/1/2013	12/31/2015	1,203,279	224,269	1,427,548	9
Energy Efficiency Awareness and Action Program	University of Kentucky	7/1/2012	9/29/2013	164,614	51,172	251,876	11
Energy Efficiency Modular Bldg.	Southern Tier Housing Corp	5/1/2013	6/30/2016	504,000	524,000	1,028,000	8
Energy Managers	Kentucky School Board Association	7/1/2013	6/30/2014	50,000	—	50,000	6
Green Bank -- Revolving Loan Fund - ARRA	Kentucky Finance and Administration Cabinet		Loan Fund	1,400,000	—	1,400,000	10
High Performance Schools Workshop	Kentucky National Energy Education Development Project (NEED)	7/1/2013	6/30/2014	38,000	—	38,000	10
HowSmartKY - On-bill Financing – Energy Efficiency Retrofit	Mountain Association for Community Economic Development (MACED)	4/22/2013	12/31/2015	300,000	320,000	620,000	9
Integrated Live Energy Management	Fayette County Public Schools	4/8/2013	12/31/2015	335,000	601,497	936,497	8
Kentucky Home Performance with Energy Star	Kentucky Housing Corporation	4/15/2013	12/31/2015	3,000,000	7,085,000	10,085,000	7
Kentucky Home Performance with Energy Star	Kentucky Housing Corporation		Loan Fund	500,000	—	500,000	7



# Appendix A—Summary of Grant Awards

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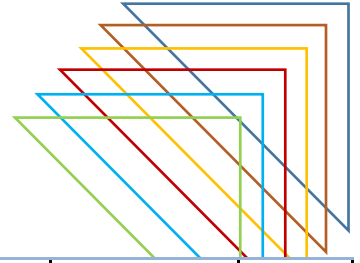


Grant Award	Recipient	Start	End	Grant Award Dollars	Matching Amount Dollars	Total Project Dollars	Page
KY Argonne Battery Development	TRK	7/1/2012	6/30/2014	154,288	—	154,288	31
Local Government – Revolving Loan Fund-ARRA	Kentucky Department for Local Government	1/1/2013	3/13/2013	760,000	—	760,000	9
Local Government Energy Retrofit Program	Kentucky Department for Local Government		Loan Fund	607,700	—	607,700	11
Low-cost biomass to biofuels	Eastern Kentucky University	3/18/2013	6/30/2014	123,662	40,515	164,177	25
Mechanical Systems Upgrades	LORD Co.	4/15/2013	12/31/2015	504,000	504,900	1,008,900	7
Modern Rock Dust	University of Kentucky	5/1/2013	6/30/2014	364,011		479,011	23
On-farm Energy Efficiency & Production	Governor's Office of Ag Policy	3/15/2013	12/31/2015	750,000	750,000	1,500,000	8
Outdoor Lighting Energy Efficiency Project	Hickman-Fulton RECC	4/15/2013	12/31/2015	316,000	335,892	651,892	31
Save Energy Now – Industrial Efficiency Program	University of Louisville	7/1/2012	9/13/2013	360,091	—	360,091	12
School Energy Managers Project	Kentucky School Board Association	4/1/2013	12/31/2015	700,000	722,259	1,422,259	6
Solar Decathlon	University of Louisville	2/15/2013	12/31/2013	30,000		30,000	17
Solar PV Project - 5 MW	Pennyrile RECC	5/1/2013	12/31/2015	3,100,000	1,263,196	4,363,196	16
Stimulating Energy Efficiency in Kentucky	Midwest Energy Efficiency Alliance	2/25/2011	9/30/2013	377,924	—	377,924	10
Underground Coal Laboratory	University of Kentucky	7/1/2012	6/30/2014	350,000	—	350,000	23



## Appendix A—Summary of Grant Awards

*continued*



Grant Award	Recipient	Start	End	Grant Award Dollars	Matching Amount Dollars	Total Project Dollars	Page
University Energy Clubs	University of Kentucky	7/1/2013	6/30/2014	30,000	—	30,000	27
Utility Efficiency Data	University of Kentucky	7/1/2013	6/30/2014	38,539	—	38,539	30
Utility Efficiency Study	University of Kentucky	7/1/2013	12/31/2013	86,520	—	86,520	30







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## **Kentucky Energy and Environment Cabinet**

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